REMARKS

By this Amendment, Claims 25, 39, 41 and 42 have been amended. Claims 25 and 28-45 are pending in the application. Reconsideration of the August 3, 2004, Official Action is respectfully requested in view of the following remarks.

First Rejection Under 35 U.S.C. § 103

Claims 25, 29, 33, 34, 37, 38, 42 and 45 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,685,942 to Ishii ("Ishii") in view of U.S. Patent No. 5,772,771 to Li et al. ("Li") and U.S. Patent No. 6,132,512 to Horie et al. ("Horie"). The reasons for the rejection are stated on pages 2-5 of the Official Action. The rejection is respectfully traversed.

Claim 25, as amended, recites a gas injector for supplying process gas to a plasma processing chamber, which comprises, *inter alia*, a "gas injector body of dielectric material and including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body and include only a single gas outlet extending in the axial direction, and the gas outlets are sized to inject the process gas at a subsonic, sonic or supersonic velocity" (emphasis added). Support for the amendment to Claim 25 is provided, for example, in Claim 42. The gas injector recited in Claim 25 is not suggested by the applied references.

Referring to Fig. 4 of Ishii, the Official Action asserts that Ishii teaches a "dielectric gas injector" 85 comprising a "gas injector body" 85 sized to extend through the chamber wall 83 of a processing chamber. The Official Action further asserts that the gas injector body includes an axial planar distal end surface exposed

within the processing chamber and gas outlets located in the axial distal end surface. Applicants disagree with these assertions.

Ishii's ground electrode 85 shown in FIG. 4 is a showerhead electrode (column 7, line 65 – column 8, line 1). As such, the ground electrode 85 necessarily is of a non-dielectric material since an electrode must be of electrically conductive material.

Neither Li nor Horie provides any suggestion or motivation to modify Ishii's ground electrode 85 to produce the gas injector recited in Claim 25. Li discloses a deposition chamber 2 including a nozzle 56. As shown in FIG. 1A, the nozzle 56 includes three separate nozzles 56a each having an orifice at its distal end. Li does not provide sufficient motivation to convert Ishii's electrode into a dielectric material and thus destroy the function of the electrode.

Horie also fails to cure the deficiencies of Ishii with respect to the gas injector recited in Claim 25. The Official Action refers to FIGs. 18A, 18B of Horie and asserts that Horie discloses a "gas distribution plate" 64. However, like Li, Horie does not provide sufficient motivation to convert Ishii's electrode into a dielectric material and thus destroy the function of the electrode. For the foregoing reasons, the gas injector recited in Claim 25 is patentable over the applied references.

Dependent Claims 29, 33, 34, 37, 38 and 45 are also are patentable over the applied references for at least the same reasons as those discussed for Claim 25.

Claim 42 has been rewritten in independent form and recites a gas injector for supplying process gas to a plasma processing chamber, which comprises "gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride and sized to extend through a chamber wall of the

processing chamber such that an axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body and the gas outlets being sized to inject the process gas at a sonic or supersonic velocity" (emphasis added).

The Official Action contends that Ishii teaches a "dielectric" gas injector. However, Ishii's alleged "dielectric gas injector 85" is a ground electrode in an opening of the insulating material 83. To the extent that the Official Action contends that Ishii's ground electrode 85 is made of a dielectric material, this assertion is incorrect. The specific group of materials for making the ground electrode 85 consists of aluminum (which is the same material as the processing housing 2), Si single crystal, SiC and C (column 4, lines 43-51). Ishii does not suggest that the ground electrode 85 could instead be made of quartz, alumina or silicon nitride, as recited in Claim 42, and thus does not suggest the gas injector recited in Claim 42.

Neither Li nor Horie provides any suggestion or motivation to modify Ishii's ground electrode 85 to make it of a dielectric material, as recited in Claim 42.

Therefore, withdrawal of the rejection is respectfully requested.

Second Rejection Under 35 U.S.C. § 103

Claims 28, 30-32, 35, 36, 39, 40, 43 and 44 stand rejected under 35 U.S.C. § 103(a) over Ishii, Li, Horie and U.S. Patent No. 6,077,357 to Rossman et al ("Rossman"). The reasons for the rejection are stated on pages 5-6 of the Official Action. The rejection is respectfully traversed.

Claims 28, 30-32, 35, 36, 43 and 44 depend from Claim 25. Rossman also fails to cure the deficiencies of Ishii's ground electrode 85 with respect to the gas injector recited in Claim 25.

The Official Action asserts that Rossman discloses a gas injection nozzle 302 including a first O-ring seal 326 and a second O-ring seal 322, 324. However, Rossman does not provide sufficient motivation to convert Ishii's electrode into a dielectric material and thus destroy the function of the electrode. Accordingly, dependent Claims 28, 30-32, 35, 36, 43 and 44 are also patentable for at least the same reasons as those discussed for Claim 25.

Independent Claim 39, as amended, recites a gas injector for supplying process gas to a plasma processing chamber, which comprises, *inter alia*, "a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply gas to the gas outlets, the cylindrical bore being defined by a sidewall and an endwall, the gas outlets including a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body" (emphasis added).

Support for the amendments to Claim 39 is provided, for example, in FIG. 3A, which depicts an exemplary embodiment of the gas injector including a cylindrical bore 44 defined by a sidewall and an endwall and adapted to supply gas to a center gas outlet 46 extending from the endwall in the axial direction, and a plurality of angled gas outlets 46 extending from the endwall at an acute angle to the axial

direction. The applied references fail to suggest the gas injector recited in Claim 39 for the following reasons.

Ishii's ground electrode 85 has a plurality of axially-extending supply ports 87 in direct fluid communication with the hollow portion 86, which in turn is in fluid communication with the cylindrical gas inlet 88a. The gas inlet 88a is not in direct fluid communication with the cylindrical gas inlet 88a. As such, the supply ports 87 cannot extend from the cylindrical gas inlet 88a. Accordingly, Ishii does not suggest the gas injector recited in Claim 39.

Furthermore, neither Li, Horie nor Rossman provides the required motivation to modify Ishii's ground electrode 85 to produce the gas injector recited in Claim 39, including the features of "a cylindrical bore adapted to supply gas to the gas outlets, the bore being defined by a sidewall and an endwall, the gas outlets including a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body." Accordingly, the gas injector recited in Claim 39 is patentable over the applied references.

Dependent Claim 40 is also patentable over the applied references for at least the same reasons as those discussed for Claim 39.

Therefore, withdrawal of the rejection is respectfully requested.

Third Rejection Under 35 U.S.C. § 103

Claim 41 is rejected under 35 U.S.C. § 103(a) over Ishii and Li in view of U.S. Patent No. 5,734,143 to Kawase et al. ("Kawase"), and further in view of Horie. The

reasons for the rejection are stated on pages 6-8 of the Official Action. The rejection is respectfully traversed.

Independent Claim 41, as amended, recites a gas injector for supplying process gas to a plasma processing chamber, which comprises, *inter alia*, a "gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body and the gas outlets being sized to inject the process gas at a subsonic, sonic or supersonic velocity, wherein the gas injector body includes a uniform diameter central bore adapted to supply gas to the gas outlets, the central bore extending axially from an upper axial end face of the gas injector body, the central bore being defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the flat endwall" (emphasis added). The applied references fail to suggest the gas injector recited in Claim 41 for the following reasons.

The Official Action acknowledges that Ishii and Li fail to suggest a gas injector having inlets of gas outlets that are located on a flat endwall. The cylindrical gas inlet 88a in Ishii's ground electrode 85 is not defined by a cylindrical sidewall and "a flat endwall extending between the cylindrical sidewall." Rather, the cylindrical gas inlet 88a is defined completely by its sidewall, and it is completely open at its bottom end at which it expands into the hollow portion 86. The axially-extending supply ports 87 are below the bottom open end of the cylindrical gas inlet 88a. Ishii does not suggest modifying the ground electrode to include a flat endwall that partially defines the cylindrical gas inlet 88a and further to form supply ports 87 in the flat endwall.

Li discloses that the center nozzle 56 is a different type of gas distributor than a showerhead. Moreover, Li discloses that the nozzles 56a each have a separate respective distal end with a gas injection orifice. As such, Li provides no motivation to modify Ishii's showerhead ground electrode 85 to include a "central bore being defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the flat endwall."

The Official Action asserts that Kawase discloses a "gas injector" (FIG. 2) including a uniform diameter central bore along axis 70 and defined by a cylindrical sidewall and a flat endwall, where inlets of the gas outlets 10 are located on the flat endwall. However, Kawase discloses a microwave plasma torch, not a gas injector.

Kawase depicts a dielectric plate 11 in FIG. 2. The dielectric plate 11 includes a bore extending through its entire thickness and having a central waveguide axis 70 for defining the propagation direction of microwaves (column 6, lines 3-7). The dielectric plate 11 also includes gas injection holes 10. During operation, discharge gas is injected through the gas injection holes 10 and into the vacuum container 1 towards the substrate 14 (see FIG. 1). The discharge gas is converted into plasma by an RF electric field caused by the microwaves, thereby forming a plasma flame 15 below the dielectric plate (FIG. 1). See column 6, lines 20-26.

Kawase discloses that the inner conductor 5b shown in FIG. 1 has a central gas inlet port 13 (column 6, line 44). However, the inlet port 13 is a separate element of the plasma torch from the dielectric plate 11, and thus is not a central bore of the dielectric plate. Moreover, the inlet port 13 is not "defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the flat endwall" (emphasis added). In contrast, the

bottom end of the inlet port 13 is completely open and the inlet port does not include an endwall extending between the sidewall. Rather, the sidewall completely defines the inlet port. Accordingly, Kawase provides no motivation to modify Ishii's ground electrode to result in the combination of features recited in Claim 41. Thus, Claim 41 is also patentable over the applied references.

Therefore, withdrawal of the rejection is respectfully requested.

Conclusion

For the foregoing reasons, allowance of the application is respectfully requested. Should the Examiner have any questions regarding this response, Applicants' undersigned representative can be reached at the telephone number given below.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: January 3, 2005

By: _____
Peter K. Skiff
Registration No. 31,917

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620